MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

ECP2046 – COMPUTER ORGANIZATION & ARCHITECTURE

(TE, RE, BE)

25 OCTOBER 2017
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

(a) This booklet consists of 4 pages including cover pages with 4 questions only.

(b) Attempt **ALL** questions given. All questions carry equal marks and distribution of the marks for each question is given.

(c) Please write all your answers in the Answer Booklet provided.

(d) All necessary working **MUST** be shown.

Question 1

(a) Describe the physical characteristics and give an example for each of the following data storage type.

(i) Volatile memory
(ii) Non-volatile memory
(iii) Non-erasable memory

[6 marks]

(b) A direct mapped cache consists of 256 lines. In a machine, the cache is used to speed-up main memory access. The main memory consists of 4096 blocks of 64 words each.

(i) How is the memory address divided into tag, line, word?

[6 marks]

(ii) How will the memory address divided, if a 2-way set associative mapped cache is used instead?

[5 marks]

(iii) Name any THREE (3) possible replacement algorithms for the set associative mapped cache.

[3 marks]

(c) A 12-bits data (along with its parity bits) 010101110110 is read-out from the memory, in which the previously stored data in memory is 010101100110. Use Hamming (8, 4) code technique to detect data bits with error based on its position. Designate the check-bits at the position 1, 2, 4, and 8 respectively.

[5 marks]

Question 2

(a) Represent (-24_{10}) and (105_{10}) using 16-bit *sign-magnitude* notation.

[2 marks]

(b) Show how $(-74_{10} + 53_{10})$ is performed using 8-bit *twos complement* notation.

[4 marks]

(c) With the aid of a flow chart diagram, illustrate how to perform *twos complement* multiplication using Booth algorithm.

[9 marks]

(d) Verify your illustration in Q2 (c) by demonstrating the multiplication of $(-3_{10} \times 7_{10})$ in binary *twos complement* notation

[10 marks]

Question 3

(a) Compare and contrast *assembly languages* to *high-level languages* such as Java and C++ for the following types of application:

(i) Business application software written for multiple platforms
(ii) Embedded Systems

[5 marks]

Continued ...

(b) Give any THREE (3) advantages and ONE (1) disadvantage of micro-programmed control unit over hardwired control unit.

[4 marks]

(c) Given program listing 3.c below and initial values in the accumulators as follow:

A = 24, B = 2, C = 3, D = 4, E = 2

(Note: values are in decimal)

Program listing 3.c

```
1  MOVE Y, A    Y ← A
2  SUB  Y, B    Y ← Y - B
3  MOVE T, D    T ← D
4  MPY  T, E    T ← T x E
5  ADD  T, C    T ← T + C
6  DIV  Y, T    Y ← Y /
```

(i) Evaluate the value of accumulator Y after line 2 in decimal.

(ii) Evaluate the value of accumulator Y after line 6 in decimal.

[6 marks]

(d) Compare one-, two-, and three-address machines by writing programs to compute

$$X = \frac{(A + B - C)}{(D - E \times F)}$$

For each of these three machines, the instructions available for use are as follows:

One-Address	Two-Address	Three-Address
LOAD M	MOVE ($X \leftarrow Y$)	MOVE ($X \leftarrow Y$)
STORE M	ADD ($X \leftarrow X + Y$)	ADD ($X \leftarrow Y + Z$)
ADD M	SUB ($X \leftarrow X - Y$)	SUB ($X \leftarrow Y - Z$)
SUB M	MUL ($X \leftarrow X \times Y$)	MUL ($X \leftarrow Y \times Z$)
MUL M	DIV ($X \leftarrow X \div Y$)	DIV ($X \leftarrow Y \div Z$)
DIV M		

[10 marks]

Question 4

(a) There are THREE (3) instruction issue policies applicable for the superscalar architecture.

(i) State which instruction issue policy has the least number of limitations.

[3 marks]

(ii) List and briefly explain the limitations of the instruction issue policy in (i).

[4 marks]

Continued ...

(b) A simple processor has four major phases to its instruction cycle: fetch, indirect, execute, and interrupt. Two 1-bit flags designate the current phase in a hard wired implementation.

(i) Why are these flags needed?
(ii) Why they are not needed in a microprogrammed control unit?

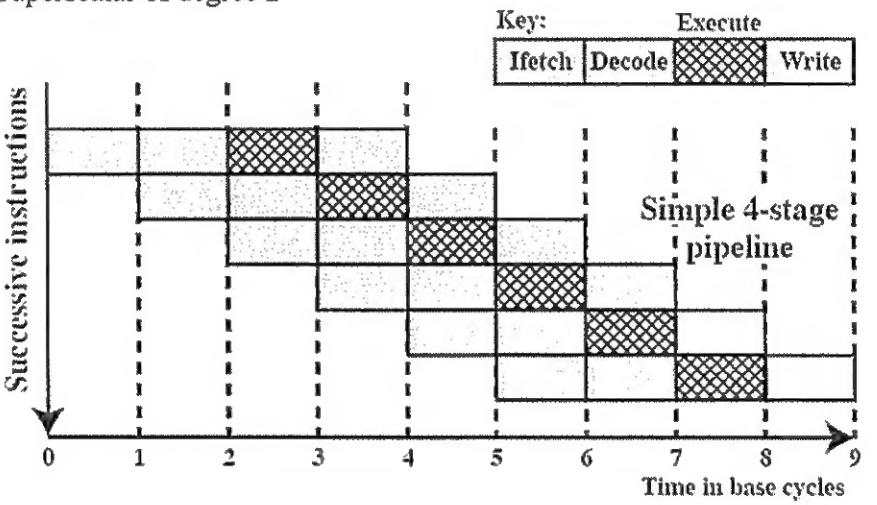
[4 marks]

(c) Compare between horizontal micro-instruction and vertical micro-instruction in terms of microprogramming. Support your answers with illustrations.

[6 marks]

(d) Fig. 4 (d) shows an execution of 6 instructions using the *pipeline* approach. Draw diagrams with the same format that show the execution of the 6 instructions using the following approaches:

(i) Superpipeline of degree 2
(ii) Superscalar of degree 2



[8 marks]

Fig. 4 (d)

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